PHY 363 QUANTUM PHYSICS – 3 CREDITS

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SCHEME OF WORK – SECOND SEMESTER

Course objectives:

When you have learnt the material in this course you would be able to:

1. Distinguish between classical and quantum phenomena
2. Use quantum principles to solve problems in modern physics
3. Explain natural phenomena using the wave phenomenon of quantum physics
4. Gain deeper insight into the rapid development in the scientific world especially in the areas of miniaturization of modern scientific equipment

de Broglie postulate

Particle nature versus wave nature of matter

The Uncertainty principle – Heisenberg uncertainty principle

Quantum principles

Operator formalism: linear operators – eigenfunctions and eigenvalues

Hermitian operators.

One dimensional systems

Schrodinger's time-independent equation. Square well of finite depth. The Harmonic oscillator. Barrier and step potentials. Tunnelling

Measurements: expectation values

Solving the Schrodinger equation for the hydrogen atom. Quantum numbers, energy levels, force and shape of the waves. Probability distribution of the waves. Measurement and expectation values.

Independent electron states in the atom

Central field approximation. The Pauli principle. The alkali metal spectrum. Dependence of n (principal quantum number) on l (orbital angular momentum quantum number). Screening effects and electron configuration

Electron spin

Orbital angular momentum and magnetic moment of a single-electron atom. Combining l and s for a single-electron atom(i. e. spin-orbit coupling). Stern-Gerlach experiment.

REFERENCES

1. The quantum theory of light – 2nd ed. Rodney Loudon – 2 copies in Departmental library
2. Fundamentals of optics – 4th F. A. Jenkins and H. E. White (this has spectrum of sodium) – 4 Copies in Departmental library
3. Atomic and nuclear physics: An introduction – T. A. Littlefield and Thorley.(this contains electron spin; the inner quantum numbers) – One copy in Departmental library
4. Nuclear and particle physics – W. S. C.Williams (this contains nuclear forces) – 2 copies in Departmental library
5. Fundamentals of college physics – Peter J. Nolan in Main Library QC 30. OK2